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Thompson J[1], O'Sullivan P[1], Briffa K[1], Neumann P[2]
1. Curtin University, 2. University of South Australia

ALTERED MUSCLE ACTIVATION PATTERNS IN SYMPTOMATIC WOMEN DURING PELVIC FLOOR MUSCLE CONTRACTION AND VALSALVA MANOUEVRE

Hypothesis / aims of study

The pelvic floor muscles (PFM) do not work in isolation but work in synergy with the abdominal muscles, chest wall and diaphragm. The muscle activation patterns around the abdominal cavity in healthy, asymptomatic women able to perform a correct PFM contraction have previously been assessed [1]. Some women find it difficult to perform a correct PFM contraction and downward displacement of the bladder base has been observed using transabdominal ultrasound in women with incontinence and prolapse when attempting to perform PF exercises [2]. The aim of this study was to investigate the muscle activation patterns around the abdomino-pelvic cavity in a specific group of women identified using transabdominal ultrasound to be depressing the bladder base when attempting to perform a PFM contraction and to compare this data to the comparable data for asymptomatic subjects identified as being able to perform a correct PFM contraction

Study design, materials and methods

A comparative study design was used. Thirteen incontinent women (mean ages 38, parity 0-5) were screened using transabdominal ultrasound and identified if they were depressing the pelvic floor when attempting a lifting PFM contraction *(symptomatic)* and thirteen healthy women (mean age 37, parity 0-3) were assessed as being able to elevate the pelvic floor when requested to perform a PFM contraction (*asymptomatic*). A digital vaginal examination was performed and the strength of the PFM graded 0-5 (modified Oxford scale). The subjects were tested in crook lying with a comfortably full bladder. The position of the bladder was monitored using transabdominal ultrasound in the sagittal plane using a 3.75MHz curved linear array probe. A marker was placed on the bladder base in the region of the greatest displacement visualized during a PFM contraction. EMG activity from the PFM, the transverse fibres of internal oblique (IO), the upper lateral fibres of external oblique (EO), rectus abdominus (RA), and the chest wall (CW), were recorded using surface electrodes. Simultaneous measurements of IAP from a sensor in the posterior fornix of the vagina were recorded. Vaginal pressure measurements using a Peritron perineometer were also carried out. The subjects were asked to perform two tasks: a PFM contraction and a Valsalva manouevre. The EMG data were normalized to the reference contraction of each muscle.

Results

The two groups were comparable in terms of age, parity, BMI and mode of delivery but the *asymptomatic* group were stronger on manual muscle testing of the PFM ($p < 0.001$). Three way ANOVA showed a significant interaction between the *group x task x muscle* ($p = 0.001$). The means (SD) of the normalized EMG activity of all the individual muscle groups for the two groups during each task are shown below Fig 1a and b. During PFM contraction the PFM were relatively less active in the *symptomatic* group ($p < 0.001$) and all the other muscles IO ($p = 0.009$), EO ($p = 0 < 0.001$), RA ($p = 0.011$) and CW ($p = 0.002$) were more active. During Valsalva manoeuvre the PFM ($p = 0.041$) and EO ($p = 0.011$) were more active in the *symptomatic* group but there was no significant difference between the two groups in the activation of the IO ($p = 0.057$), RA ($p = 0.494$) and CW ($p = 0.404$). Two way ANOVA showed a significant interaction *group x pressure* for change in IAP ($p = 0.047$) but no significant interaction for change in vaginal pressure ($p = 0.324$).

Interpretation of results

There were significant differences between the two groups in the muscle synergies used during the two tasks. During PFM contraction, the *symptomatic* group showed lower levels of PFM activation and higher levels of abdominal and chest wall muscle activation when compared to the *asymptomatic* group. The *asymptomatic* group used different muscle strategies for the two tasks but the differentiation in muscle activation patterns was less marked in the *symptomatic* group. The PFM of the *symptomatic* group were significantly weaker and they appeared to find it difficult to preferentially activate the PFM instead using

muscle substitution strategies increasing the activation of all the muscles tested. The difference in change in IAP between the two tasks was less in the *symptomatic* group

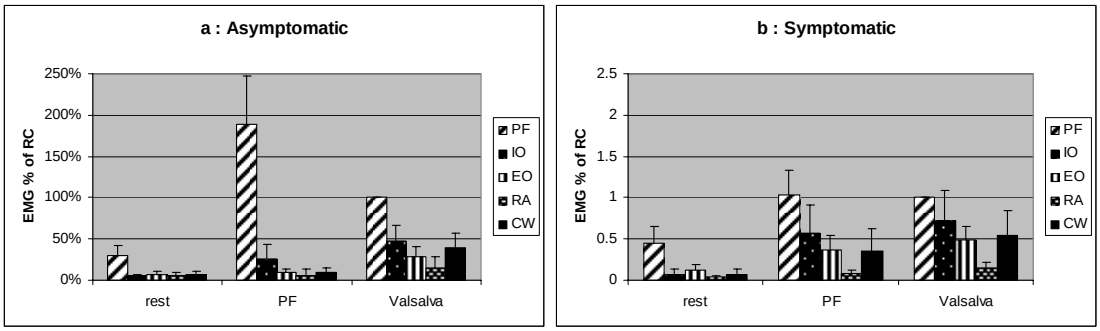

Figure 1a and b
The means (SD) of the normalized EMG activity (%reference contraction (%RC)) of all the individual muscle groups at rest, during PFM contraction and Valsalva for the a: *Asymptomatic* and b: *Symptomatic* groups

Concluding message

The *symptomatic* group displayed altered muscle activation patterns when compared to the *asymptomatic* group. The *symptomatic* women lacked a local strategy for activation of the PFM, instead using muscle substitution patterns activating all the muscles of the abdomino-pelvic cavity. The presence of muscle substitution strategies reinforces the need for close attention to specificity when prescribing PFM exercise programs. It is important to focus on the quality of the pattern of muscle recruitment so that the subject can perform a PFM contraction without dominant abdominal and chest wall muscle substitution. The early introduction of loaded or general exercise programs prior to the patient learning how to isolate the appropriate pattern may simply reinforce faulty patterns of muscle recruitment already present.

1. *Motor control strategies involved in pelvic floor elevation and depression.* Abstract ICS website ICS/IUGA, Paris 2004.
2. *Levator plate movement during voluntary pelvic floor muscle contraction in subjects with incontinence and prolapse: A cross sectional study and review.* Int Urogynecol Jnl, 2003. **12**(4): p. 84-88.

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